Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at http://about.jstor.org/participate-jstor/individuals/early-journal-content.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

GOLD IN KANSAS SHALES.

By J. T. LOVEWELL, Topeka, Kan.

Read before the Academy, at Iola, December 31, 1901.

THIS paper might be written very briefly, like the celebrated chapter on "Snakes in Ireland," by saying: "Gentlemen, there is no gold in Kansas shales." Such a summary, though delightful for its pedagogical positiveness, appears to me lacking in the element of truth; therefore unworthy of the consideration of this scientific body. In what follows, I will endeavor to state to what extent gold has been proven to exist in the shales along the Smoky Hill river in Trego and Ellis counties, and sketch briefly the extent and manner of investigation pursued under my observation.

We find in these shales abundant evidence that the region was once an ocean bed; that the shales are sedimentary deposits, which, by upheavals, by the plowing of glaciers, by the washing of prehistoric rivers, have in process of time reached the condition in which we find them.

The Smoky river, cutting its way through the shale-beds, reveals the stratification to some extent. Near the surface there is usually a hard, compact layer of fossiliferous limestone, from a few inches to a foot in thickness. Below this, the shale is softer and darker in color and more or less filled with fossils of the Benton group. Sometimes it is in thin laminations, and there will be a layer of an inch or two in thickness of yellowish material, coming probably from oxidation of pyrites. Other hard layers of compact limestone occur at irregular intervals, and this formation extends to a depth of several hundred feet, perhaps. It has been stated to me by four or five creditable witnesses that gold has been panned from the sands of the Smoky by the early gold-seeking emigrants on their way to Colorado; also, that gold has been found in several instances in sands from wells in this region.

From the United States government report published in 1848, we learn that attention had been directed in this Smoky Hill district, and a map from this report, which I have the pleasure of showing you, designated the place where is now the Smoky Hill town site as a point from which tin was obtained. The report indicates a doubt as to whether the metal they obtained was tin or zinc.

The late Cyrus K. Holliday, led by these reports and traditions, joined with a Mr. Stotz in outfitting a prospector named Ephraim Baker, who explored the region and obtained samples, which were sent to Chicago and Denver for assay. One of the certificates, in my possession, from the Chicago and Aurora Smelting and Refining Company, reports a value in gold of thirty-two dollars, and silver twenty-five cents, per ton. Baker's find was about seven years ago, and attracted considerable comment.

More or less scientific investigations ensued, and from that date until now very different conclusions have been reached. Assayers from the Atlantic to the Pacific have tested these shales. Many of them have reported absolutely no trace of gold. This class agree in results. From the rest of the tests, which vary all the way from traces up to fine values of gold and silver, worth as much as fifty dollars per ton. These persons do not agree with each other to any marked extent, and often the same assayer will find very discordant returns from the same specimen. What shall we conclude from such testimony?

In the first place, considering the sedimentary deposit where gold is found, there is a probability that it may contain anything that is found in sea-water. From several tests, I have found that the dry shale will lose about nine per cent. when heated for some time to 350 degrees centigrade. The volatile matters given off were water vapor (of crystallization) and petroleum-like substances. When heated to redness, I obtained vapors of zinc oxide.

Without undertaking to determine how the gold got into the shale, whether by precipitation from the sea-water or by alluvial deposit, it is certainly in a very fine state of division. When the shale is pulverized to 100 mesh and carefully washed with water, a residue is found which, under the microscope, shows grains of silica and pyrite and some grains of gold. Some residue yields a quantity of gold on assay, which shows that plain washing with water will produce considerable concentration of values. In the washing process, it is likely that we lose some of the very finely divided gold.

In my investigation of this shale, many modes of assay have been tried. The ore has been roasted with various kinds of fluxes before assay, and in a good many cases this preliminary treatment has been useful. In the spring of 1899, cooperating with Doctor Franklin, at Lawrence, we made over 100 assays of shale, which had been obtained from a number of different places. Many of our results were blanks, but a few showed small values in gold. In the following summer — that is, two years ago last summer — I went to the Smoky valley and took shale from many places up and down the river for several miles. I brought my specimens to Topeka and worked on them for a month, making over 100 assays. This gave small values, the last twenty averaging about one dollar to the ton. In these two series of assays, the number of blanks were greater than the number which showed values, but the shales were taken from all parts of the formations, and many of them doubtless contained no gold. Since then I have made many hundreds of assays, and I suppose the average values obtained are two dollars or three dollars a ton.

One series of sixty-six assays made last summer gave an average of $2.58 per ton. In my laboratory, recently, by concentration methods, 144 assays gave an average of $13.52 per ton. This last series of assays was joint work of several persons, all of whom were solicitous to find the exact truth, and there was no intentional error; but in work divided among several people, no one can be absolutely certain.

Last July Mr. F. H. Blake, of New York, obtained samples of shale, and had twenty-five assays made from as many different specimens by Mr. Henry E. Wood, of Denver. Six of these showed no gold, ten showed traces, and nine gave values ranging from twenty cents to sixteen dollars a ton.

In my laboratory last week, Mr. S. B. Edwards, a chemist of Colorado, made nineteen assays and obtained an average of $2.08 per ton. His highest value was $18.78, and the lowest forty-two cents per ton. His work was done on thirteen specimens collected from the shale banks by himself. I might multiply assay records of this kind, but I have given a fair sample of those which have come to my notice. The most puzzling part of the investigation is that from the same pulp, mixed as carefully as we know how to do it, very discordant values will appear. They have varied as much as fifty dollars per ton.

I have but two hypotheses to account for this discordance. The first is that the gold is not uniformly distributed, and that unwittingly, in taking our assay, we get a rich portion one time and a lean portion another. This may be true, but to one knowing the care taken in mixing the ore it does not seem likely, and is contrary to the experience of those who sample ore for commercial purposes. The other hypothesis is that, owing to the unknown and peculiar conditions of the ore, very likely to its fine divisions, the values in one case are led away by heavy vapors, while in another instance the values are in some way retained.

It may be suggested that fraud has been perpetrated in getting these results, and even if the assay is honest, others, less scrupulous, have had a share in the work. But the same experience has fallen to quite a number of assayers who are working with the greatest circumspection on specimens taken by themselves from the shale-beds.

There are other methods of analysis besides fire assays that I have tried on shales. My experiment with the chlorination process met with the following difficulty: The ore was roasted with sodium chloride. When transferred to the leaching vat, and solution of potassium permanganate and sulphuric acid added, the whole mass hardened as though it had been hydraulic lime, and we could not leach it. When a solution of cyanide of potassium with salt and hydrochloric acid is stirred up with the pulverized shale, the gold and silver will dissolve as cyanides. This is the method used by the Gage people, who claim to have obtained considerable quantities of gold from the shale. I have tried the process pretty thoroughly, and in repeated instances have I found a little gold, but nothing to compare with the results of Mr. Gage.

By long digestion of an assay ton of shale in aqua regia, then diluting and filtering, I obtained a solution which, saturated with hydrogen sulphide, gave a dark precipitate which was incinerated with the filter paper, fluxed, and cupelled, yielding 0.19 mg. of gold, representing a value of $3.80 per ton. The shale used in this experiment was brought to me, and I had no definite knowledge of where, how or by whom it was obtained, though it had the appearance of ordinary shale.

Several electrical processes have been applied to the extraction of metals from the shale, and the values obtained by these processes are higher than by any other. Besides this, they check each other better, and are interesting as another instance of where this wonderful agent, electricity, has become an handmaid to the arts.

Of the electrical schemes proposed, I will mention two. The first is the patented process devised by Mr. Motz, of South Carolina, and used by him in the gold mines there. The crushed ore is made into a sort of thin paste with water and potassium cyanide, and in this condition allowed to flow between several pairs of electrodes, through which electrical currents of the desired strength are made to pass. The metals are deposited on the cathode plates of amalgamated copper. Mr. B. F. Johnson went to South Carolina to investigate this scheme, taking quantities of shale with him. He saw the mill work under Mr. Motz's direction, and three runs gave, in one case, more than seventeen dollars per ton. A brother of the inventor, who lives at Hays, has formed a company to put this process into operation on the ground.

The other electrical scheme of which I speak is devised by Dr. Ernest Fahrig, of the Commercial Museum of Philadelphia. Doctor Fahrig is well known as one of the leading metallurgists of the country, having the advantage of high scientific attainments and long experience. I count myself fortunate in being permitted at this time to read his report, made to the gentlemen who employed him to visit Kansas and examine the shale deposit.

From these considerations, I am convinced that vast quantities of the precious metal are to be found in the Kansas shales. The questions remaining to be solved are: First, how can they be commercially extracted? Second, what is the extent of the deposit and the uniformity of the distribution? Third, if gold can be mined along the Smoky river, in Ellis and Trego counties, is it likely to be found in sedimentary deposits in other places?

In the earlier search for metals in this region, zinc was the one principally sought. No one who seeks intelligently fails to find zinc in the shales. I have tested many specimens which have fifteen per cent., and others which gave but a trace. All my tests show the presence of zinc in some quantity, but the amount is variable.

In October, 1899, M. J. Rattle, of Cleveland, Ohio, reported a value of 31.61 per cent. of zinc obtained from the shale, and, in the letter accompanying the report, expresses the greatest certainty, as well as surprise, at the result. Mr. B. F. Johnson and others, by roasting the shale and driving off and condensing the vapors, obtained a pound or more of fairly pure zinc oxide.

I have of late given but little attention to the zinc constituents of the shale, but, if treated for gold or silver, zinc may become a valuable by-product. There is also no doubt that mineral paint of the best quality can be made from the tailings, after the metal values have been extracted by the electrolytic processes.

As we stated at the outset, all elements found in sea-water might be expected as possible constituents of the shales. We know how some of the rarer elements have been discovered in residues from the salt manufactures, and in the shales we have the residues of the ages. As a purely scientific problem, I know of none more interesting than to find out what the shales are made of.

As we traverse these plains of western Kansas, where the shales are so impregnated with petroleum and bituminous products, the possibility of underlying deposits of oil, gas and coal must occur to us. That can only be determined by boring deep holes, and this will be done before many years. It is possible that some of our geological theories will have to be revised if these things are true, but that need not harm us, and geology is far from being an exact science. It is well to maintain a proper conservatism and have due caution not to be imposed upon by fakirs and sharps; but there are instances in history of carrying doubts and skepticism too far, and I appeal to the fairness of the members of the Kanssa Academy to say if this question of gold in Kansas shales does not demand most careful investigation.